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EXAMINER

TRINH, MICHAEL MANH

ART UNIT PAPER NUMBER

2822

DATE MAILED: 01/29/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/905,027

Applicant(s)

CRAIGHEAD ET AL.

Examiner

Michael M Trinh

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 18 November 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-43 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 24 is/are allowed.
- 6) ☒ Claim(s) 1-23 and 25-43 is/are rejected.
- 7) ☒ Claim(s) 8 and 19 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

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### DETAILED ACTION

\*\*\* This office action is in response to Applicant's Amendment filed on November 18, 2002.

Claims 1-43 are current pending.

\*\*\* The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

\*\*\* Re claim 24, line 6, the term "bay" should be --by--.

#### *Claim Rejections - 35 USC § 112*

1. Claim 23 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 23 recites "depositing a thin film of conformal sacrificial layer on said substrate and sidewall...removing by an unmasked RIE the thin film sacrificial layer on the sidewall and on the substrate...". However, it is unclear as to how the sacrificial wire along the base of the sidewall is to be formed if the sacrificial wire is also the sacrificial layer that is removed.

#### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

3. Claims 1-2,20-22,25-26,43 are rejected under 35 U.S.C. 102(e) as being anticipated by Tai et al (6,146,543).

Tai et al disclose a method comprising the steps of: depositing a floor layer 340 on the top surface of a substrate (Figs 3A-3G; col 4, line 10 through col 5); depositing a silicon sacrificial layer 333 on the top surface of the floor layer (col 4, lines 24-30; Figs 3B-3G);

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patterning the silicon sacrificial layer to define a shape of a desired fluid working gap; depositing a ceiling layer 343 to cover the silicon sacrificial layer (Figs 3C); and removing the silicon sacrificial layer 333 from between the floor layer and the ceiling layer to produce the working gap (Fig 3G). Re claim 2, the step of providing at least one recess hole leading to the sacrificial layer, and etching the sacrificial layer through the at least one recess hole ( Fig 3G). In re claims 20-22, wherein the device on the substrate that allows fluid transfer between working gaps and device (Fig 3G) and is fabricated in a process compatible with process of forming a working gap.

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1-4,20-22,25-26,27,28,30-32,35,38,39,43-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Tai et al (6,146,543) and in view of and further of Lin et al (5,591,139).

Mastrangelo et al also disclose a method comprising the steps of: depositing a floor layer on the top surface of a substrate (col 5, lines 57-66); depositing a sacrificial layer on the top surface of the floor layer (col 5, line 67 through col 6, line 3); patterning the sacrificial layer to define a shape of a desired fluid working gap (col 5, line 67 through col 6, line 3); depositing a ceiling layer to cover the sacrificial layer (col 6, lines 3-5); and removing the sacrificial layer from between the floor layer and the ceiling layer to produce the working gap (col 6, lines 8-10).

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Re claim 2, the step of providing at least one recess hole leading to the sacrificial layer, and etching the sacrificial layer through the at least one recess hole (col 6, lines 5-9). In re claims 20-22, wherein the device on the substrate that allows fluid transfer between working gaps and device (col 7, lines 5-12; Fig 6) and is fabricated in a process compatible with the process of forming a working gap (col 6, lines 36-38, 62-63).

Mastrangelo fails to disclose an access hole formed through the ceiling layer through the ceiling layer to sacrificial layer of silicon and a sealing layer deposited over the ceiling layer to close the access hole. Mastrangelo also fails etching the sacrificial layer using tetramethyl ammonium hydroxide.

Tai et al disclose the ceiling layer comprising a dielectric material and the sacrificial layer comprising silicon (col 4, lines 17-33). Lin et al disclose an access hole formed through the ceiling layer to sacrificial layer (col 6, lines 8-11) and a sealing layer deposited over the ceiling layer to close the access hole (col 6, lines 40-43). Tai et al also disclose an etchant comprising tetramethyl ammonium hydroxide (col 5, lines 5-35).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to recognize to substitute of silicon, as these materials are alternative for use as a sacrificial material, in modifying the ceiling and sacrificial layers of Mastrangelo to make the ceiling layer out of a dielectric material and the sacrificial layer out of silicon as taught by Tai et al in order to have a high fracture strain, low modulus material for the ceiling layer and to have a sacrificial layer that has a etch high selectivity over the ceiling layer. It also would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo to form an access hole in the ceiling layer and to deposit a sealing layer on the ceiling layer in order to close the access hole as taught by Lin et al because the formation of the access hole through the ceiling layer are easier to seal and the sealing layer is needed to seal the access hole in order to fabricate a sealed device.

6. Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212), as applied above to claim 1, and further of Mastrangelo (5,258,097).

Mastrangelo et al '212 disclose a method for fabricating a fluidic system as applied above.

Mastrangelo '212 fails to disclose the multiplicity of holes extending through the sacrificial layer to the floor layer, depositing of the ceiling layer in the holes to define obstacles in the working gaps; and removing of the sacrificial layer between the obstacles in the working gap to produce an artificial gel.

Mastrangelo '097 discloses the multiplicity of holes extending through the sacrificial layer to the floor layer (col 4, lines 9-17), depositing of the ceiling layer in the holes to define obstacles in the working gaps (col 2, lines 21-30; col 4, lines 35-53), and removing of the sacrificial layer between the obstacles in the working gap to produce an artificial gel (col 5, lines 45-50).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo '212' to form the multiplicity of holes extending through the sacrificial layer to the floor layer, to deposit of the ceiling layer in the holes to define obstacles in the working gaps, and to remove of the sacrificial layer between the obstacles in the working gap to produce an artificial gel, as taught by Mastrangelo '097 in order to provide structural support for the ceiling layer against capillary forces.

7. Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) in view of Frazier (5,871,158).

Mastrangelo et al disclose a method comprising the steps of: depositing a floor layer on the top surface of a substrate (col 5, lines 57-66); depositing a sacrificial layer on the top surface of the floor layer (col 5, line 67 through col 6, line 3); patterning the sacrificial layer to define a shape of a desired fluid working gap (col 5, line 67 through col 6, line 3); depositing a ceiling layer to cover the sacrificial layer (col 6, lines 3-5); and removing the sacrificial layer from between the floor layer and the ceiling layer to produce the working gap (col 6, lines 8-10).

Mastrangelo fails to disclose the addition of a patterned sacrificial layer, a second ceiling layer, and the removal of the sacrificial layer to produce multilevel working gaps.

Frazier discloses the formation of working gaps on multilevel (Fig 8, col 7, lines 30-41).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo '212' to form multilevel as taught by Frazier to allow different fluids to flow through different channels.

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8. Claims 11-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Frazier (5,871,158), as applied above to claim 9, and further of Lin et al (5,591,139).

Mastrangelo '212 and Frazier disclose a method for fabricating a fluidic system as applied above to claim 9, wherein the method comprises forming a multilevel fluidic device and the depositing of a sealing layer over the second sealing layer to close at least one access hole.

Mastrangelo et al fails to disclose the removing of sacrificial layers performed by etching all the sacrificial layers through at least one access hole formed in the ceiling layer, including the formation of the access hole through the topmost ceiling layer, leading to one of the sacrificial layers and at least one vertical connector hole that interconnects adjacent sacrificial layers. Mastrangelo also fails to disclose the depositing of a sealing layer over the second ceiling layer to close the one access hole.

Lin et al disclose the removing of the sacrificial layer performed by etching the sacrificial layer through at least one access hole (col 6, lines 9-11), including the formation of the access hole through the topmost ceiling layer, leading to one of the sacrificial layers and at least one vertical connector hole that interconnects adjacent sacrificial layers (col 6, lines 8-11).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo in order to form the access holes and vertical connector hole and to etch away the sacrificial layers as taught by Lin et al because the formation of the access holes through the ceiling layers are easier to seal and they provide access to the sacrificial layer. Furthermore duplication of a prior art process to accomplish a multilevel structure that would have access holes formed in every ceiling layer thus deposited would have been obvious to one of ordinary skill in the art at the time the invention was made.

9. Claims 16-18,41-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Frazier (5,871,158), as applied above to claim 9, and further of Mastrangelo (5,258,097).

Mastrangelo '212 and Frazier fails to disclose the multiplicity of holes extending through the sacrificial layer to the floor layer, depositing of the ceiling layer in the holes to define

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obstacles in the working gaps; and removing of the sacrificial layer between the obstacles in the working gap to produce an artificial gel.

Mastrangelo '097 discloses the multiplicity of holes extending through the sacrificial layer to the floor layer (col 4, lines 9-17), depositing of the ceiling layer in the holes to define obstacles in the working gaps (col 2, lines 21-30; col 4, lines 35-53), and removing of the sacrificial layer between the obstacles in the working gap to produce an artificial gel (col 5, lines 45-50).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo '212' to form the multiplicity of holes extending through the sacrificial layer to the floor layer, to deposit of the ceiling layer in the holes to define obstacles in the working gaps, and to remove of the sacrificial layer between the obstacles in the working gap to produce an artificial gel, as taught by Mastrangelo '097 in order to provide structural support for the ceiling layer against capillary forces.

10. Claims 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Lin (5,591,139), as applied above to claim 31, and further of Tai et al (6,146,543).

Mastrangelo as modified fails to disclose the ceiling layer comprising a dielectric material and the sacrificial layer comprising amorphous silicon or polysilicon.

^ Tai et al disclose the ceiling layer comprising a dielectric material and the sacrificial layer comprising polysilicon (col 4, lines 17-33).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the ceiling and sacrificial layers of Mastrangelo to make the ceiling layer out of a dielectric material and the sacrificial layer out of polysilicon as taught by Tai et al in order to have a high fracture strain, low modulus material for the ceiling layer and to have a sacrificial layer that has a etch high selectivity over the ceiling layer when TMAH is used. It also would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute amorphous silicon for polysilicon, as these materials are alternative for use as a sacrificial material.



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11. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Lin (5,591,139), as applied above to claim 30, and further of Frazier (5,871,158),

Mastrangelo as modified fails to disclose the forming of further fluidic devices on top of the already formed fluidic system and forming interconnects therebetween.

Frazier discloses the forming of further fluidic devices on top of the already formed fluidic systems and forming interconnects therebetween (col 7, lines 2-8,30-41).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the ceiling and sacrificial layers of Mastrangelo to form multilevel working gaps as taught by Frazier to allow different fluids to flow through different channels. Furthermore, the duplication of prior art process to accomplish an expected additive function or result is prima facie obvious absent a disclosure that the process is for a particular unobvious purpose, produces an unexpected result, or is otherwise critical.

12. Claims 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Lin (5,591,139), as applied above to claim 30, and further of Vaeth (US2001/0005527).

Mastrangelo as modified fails to disclose the layers being formed using chemical vapor deposition.

Vaeth discloses the layers being formed using chemical vapor deposition (paragraph 9).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo to form the layers using chemical vapor deposition process as taught by Vaeth in order to use a method the produce a relatively thin polymer layer with no holes therein.

13. Claim 40 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Lin (5,591,139), and further of Nakagima et al (4,698,407).

Mastrangelo et al disclose a method comprising the steps of : depositing a sacrificial layer on a substrate (col 5,lines 67 to col 6); lithographically patterning the sacrificial layer (col 6,lines 1-3); depositing a ceiling layer on the patterned sacrificial layer (col 6,lines 3-5); forming access

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holes (col 6, lines 5-7); and etching the patterned sacrificial layer via the access holes (col 6, lines 8-9).

Mastrangelo fails to disclose the formation of the access holes through the ceiling layer and the oxidation of the access holes.

Lin et al disclose the formation of access holes through the ceiling layer (col 6, lines 1-11). Nakagima discloses the oxidation of the access holes (col 1, lines 15-21). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo to form the access holes through the ceiling layer as taught by Lin et al and to oxidize the access hole as further taught by Nakagima et al because the formation of the access holes through the ceiling layer are easier to seal and the oxidation of the access holes are needed to seal the access hole openings in order to fabricate a sealed device.

#### ***Allowable Subject Matter***

As of record,

\*\*\* Claim 24 is allowed.

\*\*\* Claims 8 and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

#### **Response to Amendment**

14. Applicant's remarks (11/18/02) with respect to pending claims have been considered but are moot in view of the new ground(s) of rejection.

Moreover, Tai discloses to remove a silicon sacrificial layer formed between a floor layer and the ceiling layer in order to form a working gap.

Applicant remarked that Mastrangelo teaches the "polymer based micromachining process" is better than silicon based processes, which is directly against the teaching of, themselves, Mastrangelo et al.

In response, it is noted and found unconvincing. Mastrangelo teaches both systems including "polymer based micromachining process" and "silicon based processes", and

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preferably to use the polymer based processes to form the system. Although each processes has advantages and disadvantages, it is totally different from teaching away for not using one "silicon based process".

There is no proper response to rejection of claim 23 under 35 USC 112, second paragraph.

\*\*\*\*\*

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

\*\*\* Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (703) 308-2554. The examiner can normally be reached on M-F: 8:30 Am to 5:00 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Oacs



Michael Trinh  
Primary Examiner